

Cucumaria flamma, a new species of sea cucumber from the central eastern Pacific (Echinodermata: Holothuroidea)

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Abstract.—*Cucumaria flamma*, n. sp. from the central eastern Pacific is of medium size with mouth and anus terminal, directed upward; a conspicuous deep antero-posterior groove in the dorsal skin extending from near base of tentacles to anus. Ventral skin ossicles are knobbed buttons and smooth perforated plates, dorsal skin ossicles are smooth perforated plates and smooth buttons. Distributed from Mazatlán, Sinaloa, México to Isla de la Plata, Ecuador from 4 to 12 m on rocky substrata.

Resumen.—*Cucumaria flamma*, n. sp. del Pacífico este central, es una especie de talla mediana, con boca y ano en posición terminal, dirigidos hacia arriba, con un surco antero-posterior en la superficie dorsal, que se extiende desde cerca de la base de los tentáculos hasta el ano. Los osículos de la pared ventral del cuerpo son botones abollonados y placas lisas perforadas, los de la pared dorsal son placas lisas perforadas y botones lisos. Distribuido desde Mazatlán, Sinaloa, México hasta Isla de la Plata, Ecuador, de los 4 a los 12 m de profundidad, sobre substratos rocosos.

Of the two hundred and forty seven species currently named in the family Cucumariidae, the genus *Cucumaria* (Subfamily Cucumariinae), embraces one hundred and sixty four. As far as we know, three of these species occur in the central eastern Pacific: *Cucumaria crax* Deichmann, 1941, *C. pseudocurata* Deichmann, 1938 and *C. salma* Yingst, 1972. Lambert (1998a) removed *C. curata* Cowles, 1907 from the genus based on morphology and DNA evidence. The systematic status of certain groups within the family remains somewhat confused, but the works of Panning (1949–1971), Pawson & Fell (1965), Pawson (1970, 1982) and Lambert (1998a, 1998b) are steadily eliminating the confusion. The purpose of this paper is to describe a new species of *Cucumaria* from the eastern Pacific coast.

Material and Methods

Live specimens were relaxed with chloral hydrate and fixed with 70% ethyl alcohol. Ossicles were extracted from pieces of skin (4 mm square) from mid-dorsal and mid-ventral body wall, tentacles and introvert. The skin was dissolved with fresh household bleach in centrifuge tubes. After centrifugation at 2750 rpm for 10 minutes, bleach was pipetted off and the ossicles were flooded and centrifuged three times with ethyl alcohol. After drying, the ossicles were observed by scanning electron microscopy.

Results

Order Dendrochirotida Grube, 1840
Family Cucumariidae Ludwig, 1894

Diagnosis.—Body wall essentially soft, ossicles small and inconspicuous. Calcare-

ous ring simple, lacking posterior processes. Usually 10–20 tentacles are present; tube feet most commonly restricted to the radii, where they may be scattered or arranged in regular rows. In several species some feet may also be scattered in dorsal interradii (after Pawson 1982).

Remarks.—The family was emended by Pawson & Fell (1965).

Subfamily Cucumariinae Panning, 1949

Diagnosis.—Ten tentacles. Calcareous ring simple, low, without forked tails, or at most medium high, with short undivided forked-tails, the radials and inter radials undivided. In the skin, only plates, no cups, no tables, no table-like constructions (after Panning 1949).

Genus *Cucumaria* de Blainville, 1834

Diagnosis.—Ten tentacles, of equal size, or the ventral ones smaller. Feet large, soft, in 5 bands, in some forms also scattered in the interradii, particularly dorsally. Calcareous ring low, simple. Ossicles plates or buttons, knobbed or smooth, often reduced. Feet with simple end plates or none at all; walls of feet supported by rods, often 3 armed, or plates. Introvert and tentacles with perforated plates and rods. Ossicles show tendency to become reduced in many forms (after Deichmann 1941). Type species: *Cucumaria frondosa* Gunnerus, 1770.

Remarks.—The diagnosis embraces only the members of the genus *Cucumaria* sensu stricto. The genus contains about 165 described and attributed species, of which about 43 are currently recognized. The genus was emended by Panning (1949).

Cucumaria flamma, new species Figs. 1–5

Pattalus mollis Nepote, 1998: 50–52, fig. 16. Non: *Pattalus mollis* Selenka, 1868.

Diagnosis.—Body curved, mouth and anus terminal, directed upward. Medium

size form, reaching a length of approximately 150 mm; skin soft, smooth; feet soft, large, retractile, particularly abundant in ventral region, not arranged in bands, also present in interambulacra. A conspicuous antero-posterior deep groove in dorsal skin extends from near base of tentacles to anus. Ten large dendritic tentacles with broad base, soft, richly branched, bushy; often deep orange, speckled with black. Calcareous ring simple, low and stout with short anterior projections, lacking posterior processes. Radial and interradii pieces almost same size. Ventral skin ossicles four to six-holed knobbed buttons (110–150 μm) and less abundant smooth perforated plates (200 μm). Dorsal skin ossicles smooth perforated plates and smooth buttons with two central holes bigger than rest. Introvert with star-shaped (~ 340 μm) or elongated perforated plates (200 μm). Tentacle ossicles in two forms: abundant large, perforated, robust rods, tree-branched, curved or elongated, and scarce oval perforated plates, with scalloped margins.

Material examined.—Thirty specimens from 9 localities on the Mexican Pacific Coast: four in Sinaloa, one in Nayarit, one in Colima and three in Guerrero, and two localities in Central America: one in Panama and one in Ecuador (Fig. 5). Number of specimens in parentheses after the catalogue number; depth in meters (m). The abbreviations used in this paper are: United States National Museum (USNM), California Academy of Sciences (CASIZ), Royal British Columbia Museum (RBCM), Natural History Museum of Los Angeles County (LACM), Instituto de Ciencias del Mar y Limnología, Colección Nacional de Equinodermos, Universidad Nacional Autónoma de México (ICML-UNAM).

Holotype.—USNM E48072 (1), collected by F. A. Solís-Marín & R. Ramírez-Murillo, 18 Jun 1993, length 142 mm (measured along the outside of the curved body), female.

Type locality.—Mexican Pacific coast, La Pedregosa Beach, Zihuatanejo, Guerre-

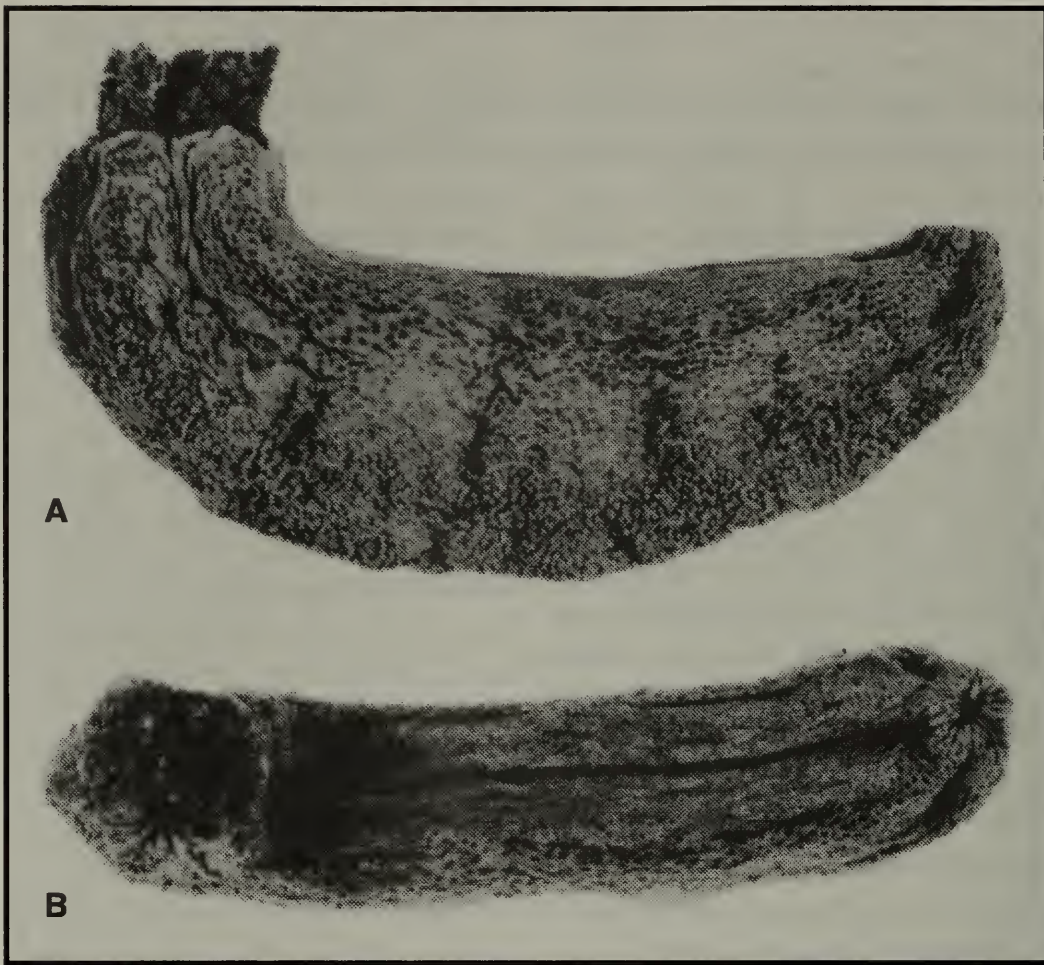


Fig. 1. Paratype of *Cucumaria flamma* collected by scuba from 6 m, Playa La Pedregosa, Zihuatanejo, Guerrero, Mexico, ($17^{\circ}37'06''\text{N}$, $101^{\circ}31'52''\text{W}$), length 140 mm, ICML-UNAM 5.8.0. Female. 1A, left lateral view. 1B, dorsal view. Note conspicuous dorsal groove.

ro, Mexico, ($17^{\circ}37'06''\text{N}$, $101^{\circ}31'52''\text{W}$), 6 m, rocky substrate.

Paratypes.—USNM E48073 (1), collected by F. A. Solís-Marín & R. Ramírez-Murillo, 18 Jun 1993, La Pedregosa Beach, Zihuatanejo, Guerrero, Mexico, ($17^{\circ}37'06''\text{N}$, $101^{\circ}31'52''\text{W}$), 6 m, rocky substrate, specimen length 141 mm. ICML-UNAM 5.8.0 (2), collected by F. A. Solís-Marín & R. Ramírez-Murillo, 18 Jun 1993, Playa La Pedregosa, Zihuatanejo, Guerrero, Mexico, ($17^{\circ}37'06''\text{N}$, $101^{\circ}31'52''\text{W}$), 6 m, rocky substrate, specimens length from 130 to 151 mm. ICML-UNAM 5.8.1 (1), collected by Elaine M., Playa La Peruana, Morro Pulpito, Colima, Mexico, 6 m, 10 Jan 1995, length 62 mm. ICML-UNAM 5.8.2 (1), Collected by J. M. Salcedo, 22 Nov 1981, Morro del Tigre, Bahía de Zihuatanejo,

Guerrero, Mexico, ($17^{\circ}38'04''\text{N}$, $101^{\circ}33'07''\text{W}$), 5 m, rocky substrate, specimen length 90 mm. ICML-UNAM 5.8.3 (6), Collected by Facultad de Ciencias, UNAM, 5 Sep 1965, Playa Las Gatas, Zihuatanejo, Guerrero, Mexico, ($17^{\circ}38'10''\text{N}$, $101^{\circ}33'0''\text{W}$), 4 m, rocky substrate, specimens length from 55 to 132 mm. ICML-UNAM 5.8.4 (1), Collected by Caso, M. E., 17 Jun 1980, Isla Cardones, Bahía de Mazatlán, Sinaloa, Mexico, ($23^{\circ}11'09''\text{N}$, $106^{\circ}24'24''\text{W}$), 8 m, rocky substrate, specimen length 85 mm. ICML-UNAM 5.8.5 (2), Collected by O. López, 19 Mar 1992, Isla Venados, Bahía de Mazatlán, Sinaloa, Mexico, ($23^{\circ}15'39''\text{N}$, $106^{\circ}28'38''\text{W}$), 12 m, rocky substrate, specimens length from 99 to 130 mm. ICML-UNAM 5.8.6 (3), Collected by O. López, 22 Mar 1992, Off Isla Cardones, Bahía de

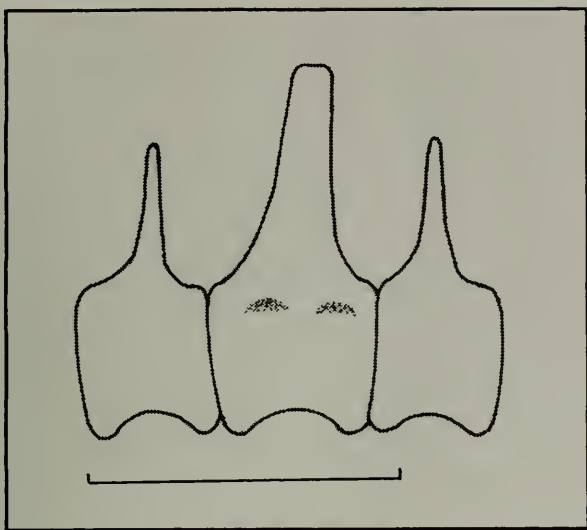


Fig. 2. Calcareous ring of *Cucumaria flamma*; scale bar 6 mm. From paratype (USNM E48073), one radial and two interradials pieces.

Mazatlán, Sinaloa, Mexico, (23°11'04"N, 106°24'23"W), 10 m, rocky substrate, specimens length from 80 to 125 mm. ICML-UNAM 5.8.7 (1), Collected by O. López, 25 Jan 1992, Isla Chivos, Bahía de Mazatlán, Sinaloa, Mexico, (23°13'46"N, 106°27'53"W), 8 m, rocky substrate, specimen length 85 mm. ICML-UNAM 5.8.8 (1), Collected by M. E. Caso, 25 Jan 1983, Isla Cardones, Bahía de Mazatlán, Sinaloa, Mexico, (23°11'03"N, 106°24'10"W), 8 m, rocky substrate, specimen length 102 mm. ICML-UNAM 5.8.9 (1), Collected by M. E. Caso, 24 Jan 1983, Isla Pájaros, Bahía de Mazatlán, Sinaloa, Mexico, (23°15'00"N, 106°28'52"W), 10 m, rocky substrate, specimen length 90 mm. ICML-UNAM 5.8.10 (2), Collected by M. E. Caso, 20 Jan 1983, Isla Venados, Bahía de Mazatlán, Sinaloa, Mexico, (23°15'39"N, 106°28'38"W), 4 m, rocky substrate, one specimen length 72 mm, the other specimen was partially destroyed. ICML-UNAM 5.8.11 (1), Collected by A. C., Nepote, 20 May 1996, Islas Marietas (Isla Larga), Bahía de Banderas, Nayarit, Mexico (20°41'98"N, 105°34'72"W), 4 m, rocky substrate, specimen length 120 mm. ICML-UNAM 5.8.12 (1), Collected by F. A. Solís-Marín, 21 Mar 1996, Islas Marietas (Isla Redonda), Bahía

de Banderas, Nayarit, Mexico (20°42'04"N, 105°33'53"W), 10 m, rocky substrate, specimen length 132 mm. USNM E47607 (1), Collected by Emler, R., 14 Nov 1983, North Pacific Ocean, Panama, Taboguilla Island, depth unknown, subtidal rock holes, specimen length 139 mm. USNM E47750 (1), Collected by F. Rivera, May 1998, Isla de La Plata, Ecuador, (1°16'N, 81°06'W), 5 m, rocky substrate and coral debris, specimen length 104 mm (female). CASIZ 102949 (1), Collected by O. López, 22 Mar 1982, Off Isla Cardones, Bahía de Mazatlán, Sinaloa, Mexico, (23°11'04"N, 106°24'23"W), 10 m, subtidal rock holes, specimen length 100 mm. RBCM 999-00015-001 (1), Collected by Facultad de Ciencias, UNAM, 5 Sep 1965, Playa Las Gatas, Zihuatanejo, Guerrero, Mexico, (17°38'10"N, 101°33'0"W), 4 m, rocky substrate, specimens length 80 mm. LACM 92-193.1 (1), Collected by O. López, 19 Mar 1992, Isla Venados, Bahía de Mazatlán, Sinaloa, Mexico, (23°15'39"N, 106°28'38"W), 12 m, rocky substrate, specimens length 99 mm.

Description.—Total length 55–151 mm (measured along the greater curvature of the body); mean length 101 mm. Holotype 141 mm long. Body curved, mouth and anus terminal, directed upward; anterior region wider than posterior. Deep groove in dorsal region, runs from near base of tentacles to anus (Fig. 1a, b). Skin soft, smooth. Podia slender, soft, large, retractile, widely dispersed and particularly larger and abundant in ventral region, not arranged in bands; also present in interambulacra. Specimens typically deep red, tentacles deep orange with black tips in life and reddish brown in alcohol. Ten tentacles almost equal. Madreporite in dorsal mesentery about one-half of distance from anterior end of calcareous ring. Circular, bilobate madreporite with a long narrow stone canal. Two polian vesicles on ventral side of ring. From left and right sides of cloaca arise two respiratory trees; each splits into a dorsal and ventral branch; in left side tree, ventral

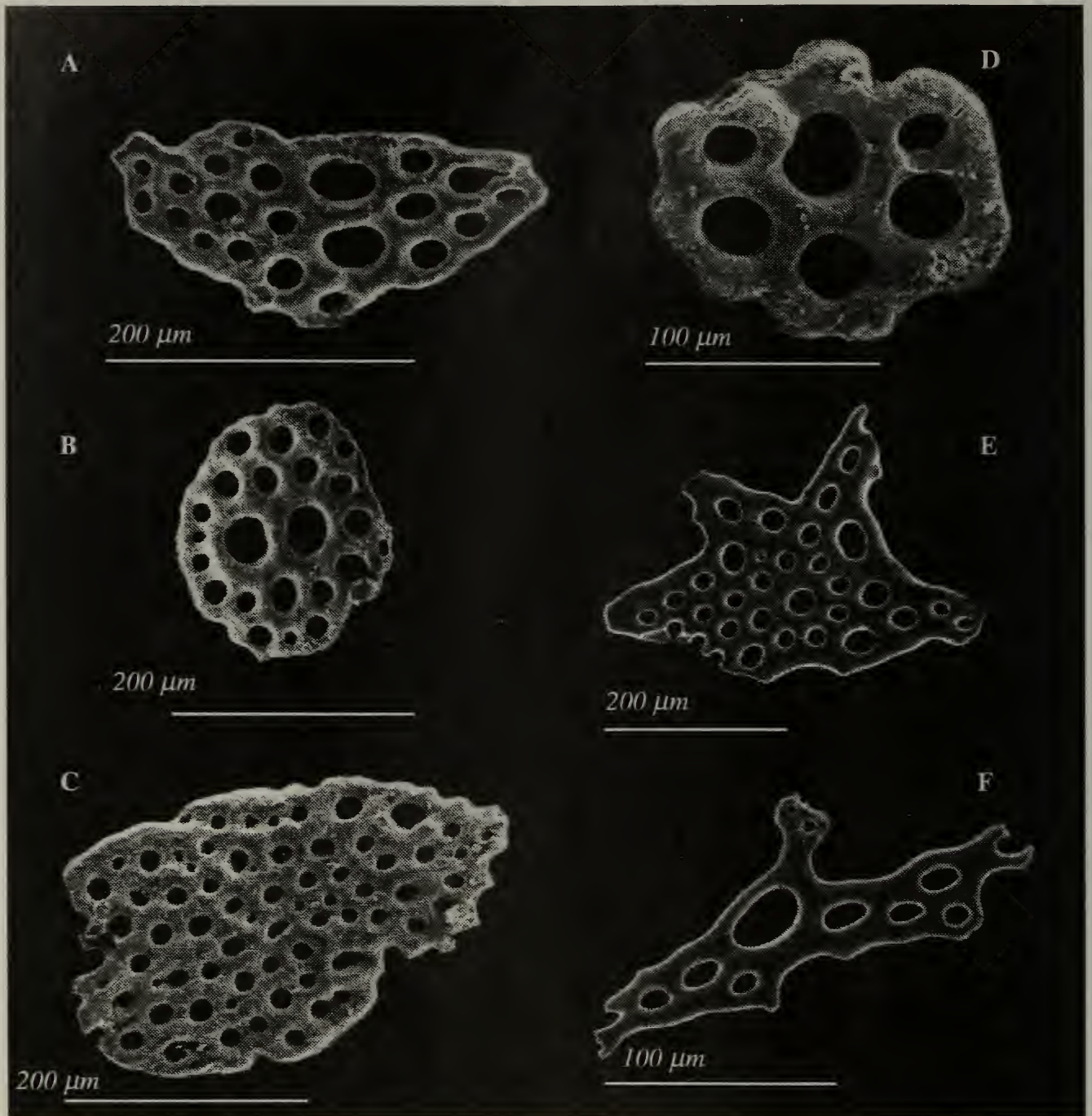


Fig. 3. Ossicles of *Cucumaria flamma*. (a-d) dorsal skin ossicles, smooth perforated plates and smooth buttons with two central holes; (e-f) Introvert with star-shaped and elongated perforated plates. All from holotype (USNM E48072).

branch runs full length of body, the dorsal branch three-quarters of length, in right tree, ventral branch runs the full length of body but the dorsal branch runs to middle of body because of presence of gonad mass (in mature specimens). Respiratory trees usually light brown or yellowish, each with a main trunk. Cloaca occupies approximately one-tenth of length of the body. Gonads arranged in two tufts of unbranched

tubules, attached by a mesentery to right-mid dorsal side of the body.

Thin retractor muscles join to body wall at a point level with anterior end of calcareous ring. Plates of calcareous ring almost of same size, with anterior projections, radials longer than interradials; anterior projection of interradials narrower than radials (Fig. 2).

Dorsal skin ossicles smooth perforated

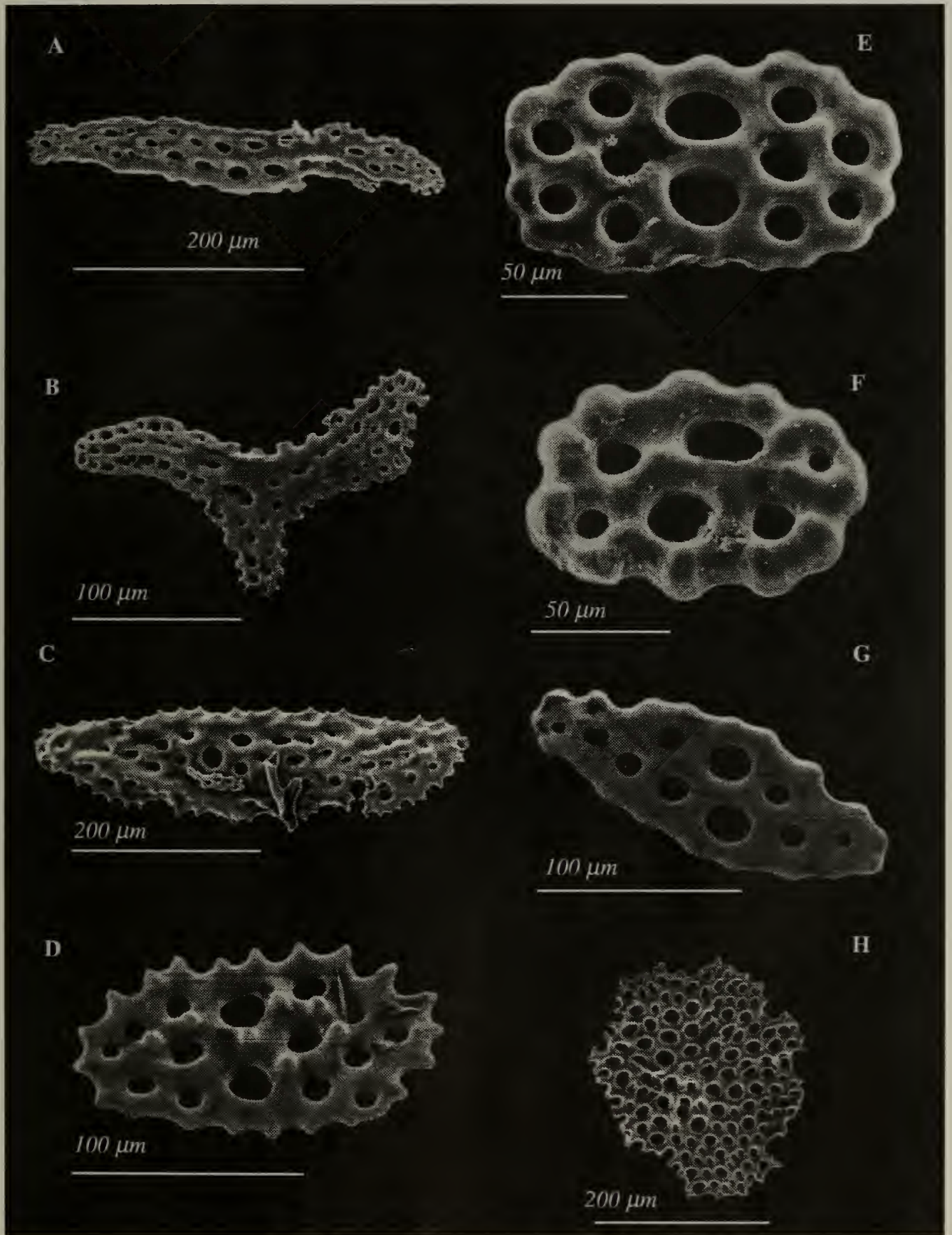


Fig. 4. Ossicles of *Cucumaria flamma*. (a–d) tentacle ossicles; (e–g) ventral skin ossicles; (h) end plate of podia. All from holotype (USNM E48072).

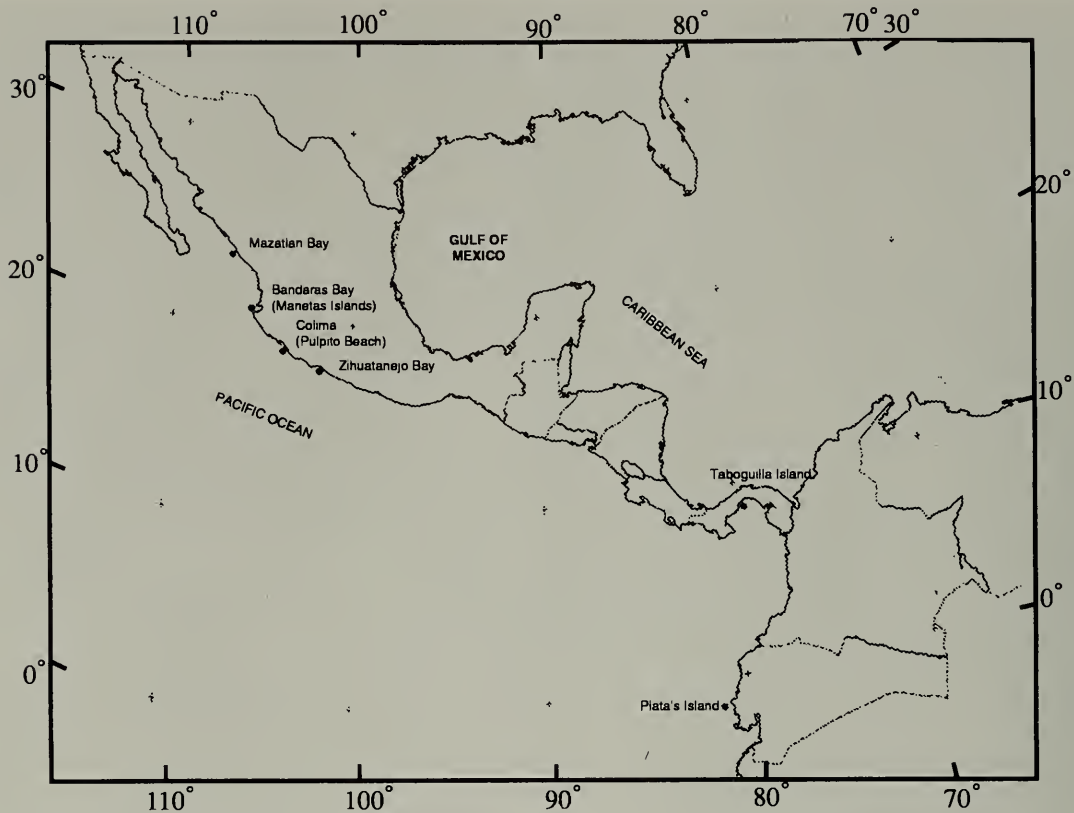


Fig. 5. Collection sites for *Cucumaria flamma*.

plates and smooth buttons with two central holes (Fig. 3a–d). Introvert with star-shaped ($\sim 340 \mu\text{m}$) and elongated perforated plates ($200 \mu\text{m}$) (Fig. 3e, f). Tentacle ossicles perforated, robust rods, three-branched, curved or elongated, and scarce oval perforated plates, with scalloped margins (Fig. 4a–d). Ventral skin ossicles: abundant knobbed buttons ($110\text{--}150 \mu\text{m}$) and smooth perforated plates ($200 \mu\text{m}$). Knobbed buttons usually with four or sometimes six holes (Fig. 4e–g). Curved perforated rods in podia, end plates of $270\text{--}290 \mu\text{m}$ in diameter (Fig. 4h). Skin ossicles seem to disappear as the animal grows.

Etymology.—The specific epithet *flamma* in Latin means “flame, blaze or fire”. It is here used as a noun in apposition and refers to the color of the skin and the tentacle crown of live specimens.

Distribution and habitat.—*Cucumaria flamma* is known from the Mexican Central Pacific, from Mazatlán, Sinaloa ($23^{\circ}15'39''\text{N}$, $106^{\circ}28'38''\text{W}$) to Isla de la Plata, Ecuador ($1^{\circ}16'\text{N}$, $81^{\circ}06'\text{W}$), (Fig. 5). It ranges in depth from 4 to 12 m. The majority of col-

lections are from less than 10 m. Usually occurs on rocky substrates, in cavities and holes.

Discussion

Cucumaria flamma is distributed from Sinaloa, Mexico (in the mouth of the Gulf of California) to Isla de la Plata, Ecuador. As far as we know, eight species of the genus that could share this distribution area are: *C. frondosa japonica* (Gunnerus, 1767); *C. miniata* (Brandt, 1835); *C. piperata* (Stimpson, 1864); *C. pseudocurata* Deichmann, 1938; *C. salma* Yingst, 1972; *C. crax* Deichmann, 1941; *C. pallida* Kirkendale & Lambert, 1995 and *C. vegae* Théel, 1886 (Deichmann 1938, 1941; Bergen 1996; Lambert 1997). *C. flamma* is the largest of the *Cucumaria* species on Mexican coasts. It has the typical *Cucumaria* shape (Fig. 1a, b). It can attain a length of 150 mm and longer, depending on its state of relaxation.

Externally, *C. flamma* is similar to *C. miniata*, but the arrangement of the tube

feet distinguishes them. *C. miniata* has five bands of tube feet separated by broad expanses of smooth skin, and occasional scattered tube feet. *C. flamma* has very widely dispersed tube feet not arranged in bands, particularly abundant in the ventral region. No other cucumariid exhibits the antero-posterior dorsal groove characteristic of *C. flamma*.

Cucumaria flamma is allied to *C. pseudocurata* in the shape of the smooth buttons ossicles of the body wall with two central holes, but those of *C. flamma* have broad and knobbed edges. The buttons of *C. pseudocurata* are smaller (about one-third of diameter) than those of *C. flamma*. *C. pseudocurata* also resembles *C. flamma* in the shape of the calcareous ring, but the radial plates in *C. pseudocurata* are slender, longer and with long anterior prolongations in comparison to *C. flamma*, that have broad radial plates with short anterior prolongations.

The knobbed plate ossicles present in the body wall may be reminiscent of *Cucumaria lubrica* H. L. Clark (formally *Pseudocnus lubricus*); Lambert (1997, 1998a) placed this species in the genus *Pseudocnus* based on the distribution of tube feet, the complex button ossicles and DNA evidence.

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Jorge A. Ornelas Ibáñez arranged and prepared the figures.

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